Space Weather Technical Forecast

Issued on Friday, 09 August 2024 at 13:10 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares expected with a chance of isolated X-class flares. Occasional G1-G2/Minor to Moderate geomagnetic storms likely, mainly Days 2 and 3 (10 and 11 Aug).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: High solar activity with one X-class flare peaking at X1.3 at 08/1935 from AR3777, plus four M-class flares through the period. There are nine sunspot regions visible on the disc, of which eight are numbered. AR3780 remains the largest, with moderate magnetic complexity, featuring a prominent large negative intermediate spot and a cluster of smaller spots to its south and west. AR3774 and AR3777 remain moderately size regions located close together in the southwest, with AR3777 showing a slightly more complex magnetic structure. AR3781 is a relatively small region to the northwest, however it appears to have a small delta region in its trailing spot. The remaining regions on the disc have either been stable or shown very little change.

A CME associated with X1.3 flare produced a complex halo which has been analysed to have an Earth directed component. This CME has the potential to arrive at Earth later Day 3 (11 Aug) though there is considerable uncertainty due to the challenging analysis.

Solar Wind / Geomagnetic Activity: Slow-ambient solar wind conditions mostly persisted through the period, although wind speeds did touch into slightly elevated levels at times peaking around 420 km/s at 09/0857UTC. Density remained at or below average. Interplanetary Magnetic Field, Bt, was Weak, 7nT or below while the north-south component was Weak and variable in direction, between -6nT and +6nT. Phi angle was negative (towards the Sun). Geomagnetic activity was Quiet (Kp1-2)

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background. The 24-hour fluence was below the Active threshold with 1.46e6 integrated pfu observed at 09/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast to continue, with occasional M-class flares expected and a slight chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: There is potential for multiple CMEs to arrive on Day 2 (10 Aug), but confidence remains low due to the complex halos produced by these CMEs and coinciding far side events, which complicate analysis. Additionally, a CME associated with the X1.3 flare at 08/1935UTC, which also produced a complex halo, has been analysed to have an Earth directed component and may arrive at Earth later Day 3 (11 Aug). Despite the uncertainty, it is likely there will be some CME influence through Day 2-3(10-11 Aug) though confidence in the forecast is low due to the challenging analysis.

Geomagnetic activity is expected to be mostly Quiet to unsettled (Kp1-3) initially, with a chance of isolated Unsettled intervals. From Day 2 (10 Aug) occasional G1 -G2/Minor to Moderate Storms

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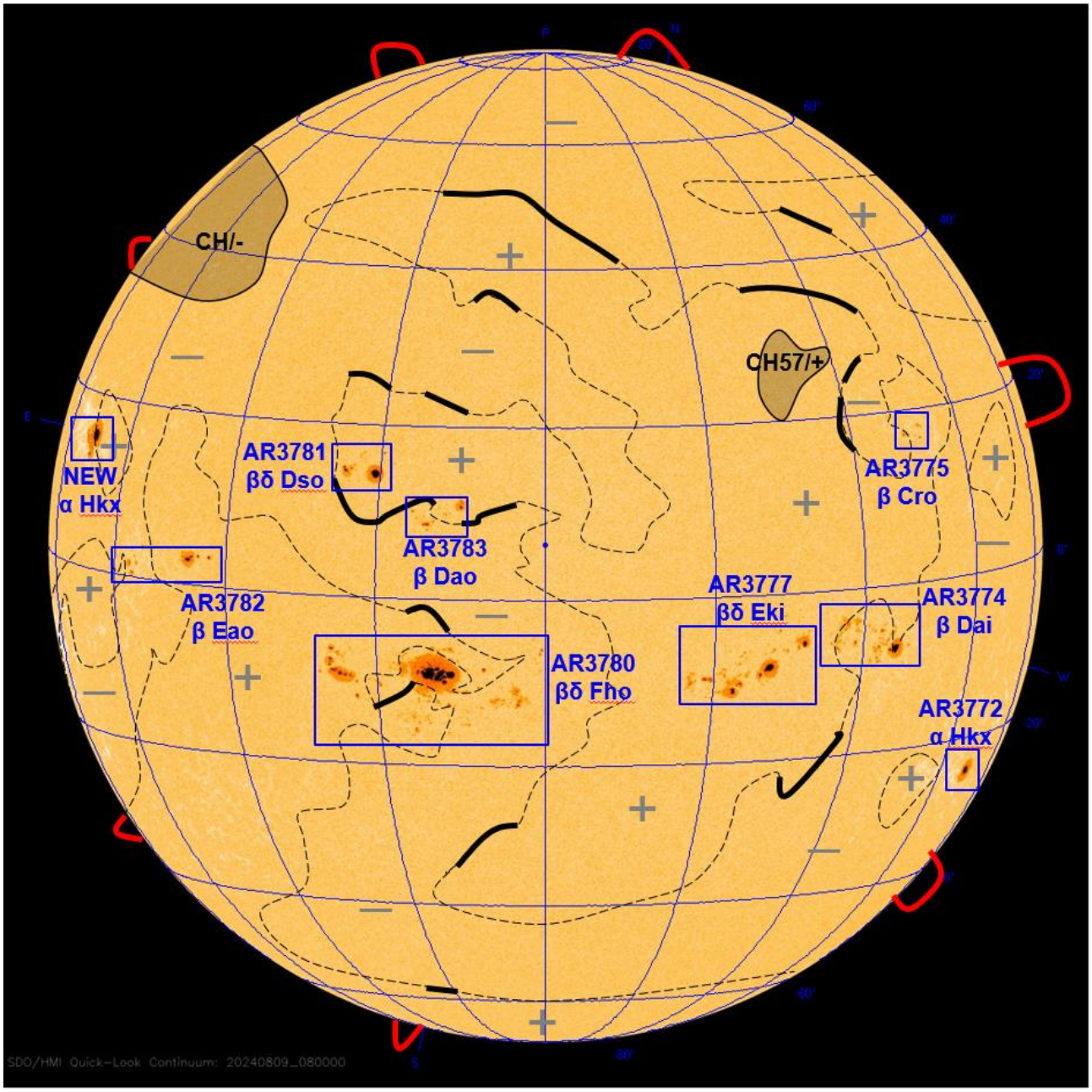
periods are expected, with a slight chance of G3/Strong storms. Geomagnetic activity is then expected to decline back to mostly quiet to unsettled through Day 4 (12 Aug).

Energetic Particles / Solar Radiation: High energy proton flux, as observed by GOES-18, is expected to persist at background throughout the period. Any strong flares will bring the potential for a slight chance of reaching/exceeding the S1 Minor Radiation storm level. The high energy electron flux is forecast to be at mostly background levels. The associated 24-hour fluence is expected to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 09/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Two CMEs occurred on the 07 Aug, one associated with the M4.5 flare from AR3774 at 07/1350UTC and a second associated with the M5.0 flare from AR3777 at 07/1854UTC. These CMEs both produced complex halos and the earlier may have coincided with a far sided event, complicating analysis. These CMEs may arrive together, with ENLIL analysis giving an arrival time during the morning on Day 2 (10 Aug) but this is prone to high uncertainty due to interference on coronograph imagery. Additionally the filament eruption CME which left the Sun on 07 Aug is expected to pass close later on Day 2 (10 Aug), with glancing impacts possible. As a result, it is likely there will be some CME influence through Day 2 (10 Aug) but confidence remains low.

A further CME associated with the X1.3 flare from AR3774 at 08/1935UTC also produced a complex halo, which has been analysed to have an Earth directed component. This CME has the potential to arrive at Earth later Day 3 (11 Aug) though there is considerable uncertainty due to the challenging analysis.

The above CMEs combined with the possible arrival of a weak HSS from CH57 gives a chance of G1-G2/Minor to Moderate geomagnetic storms from Day 2 (10 Aug), although it should be noted MOSWOC ENLIL is currently verifying poorly and over-predicting wind speeds in associated with CH57, providing further uncertainty to the forecast.

Geomagnetic activity is expected to be mostly Quiet to unsettled (Kp1-3) initially, with a chance of isolated Unsettled intervals. From Day 2 (10 Aug) occasional G1 -G2/Minor to Moderate Storms periods are expected, with a slight chance of G3/Strong storms. Geomagnetic activity is then expected to decline back to mostly quiet to unsettled through Day 4 (12 Aug).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	70	70	20
Strong	G3	No	1	15	15	1
Severe	G4	No	1	5	1	1

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Extreme	**G5**	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
07/1820 UTC	Partial	M4.5	SW - AR3774	660 km/s	10/0600 UTC	Low confidence due to far sided event interfering with coronagraph imagery
09/0001	Full halo	X1.3 flare	SW AR3777	750 km/s	11/1600 UTC	Complex halo causing a difficult analysis, hence also low confidence.

Figure 2: MOSWOC ENLIL showing possible CME impacts on the 10th and 11th. H owever Enlil has a poor representation of current conditions with an anomalous coronal hole fast wind.

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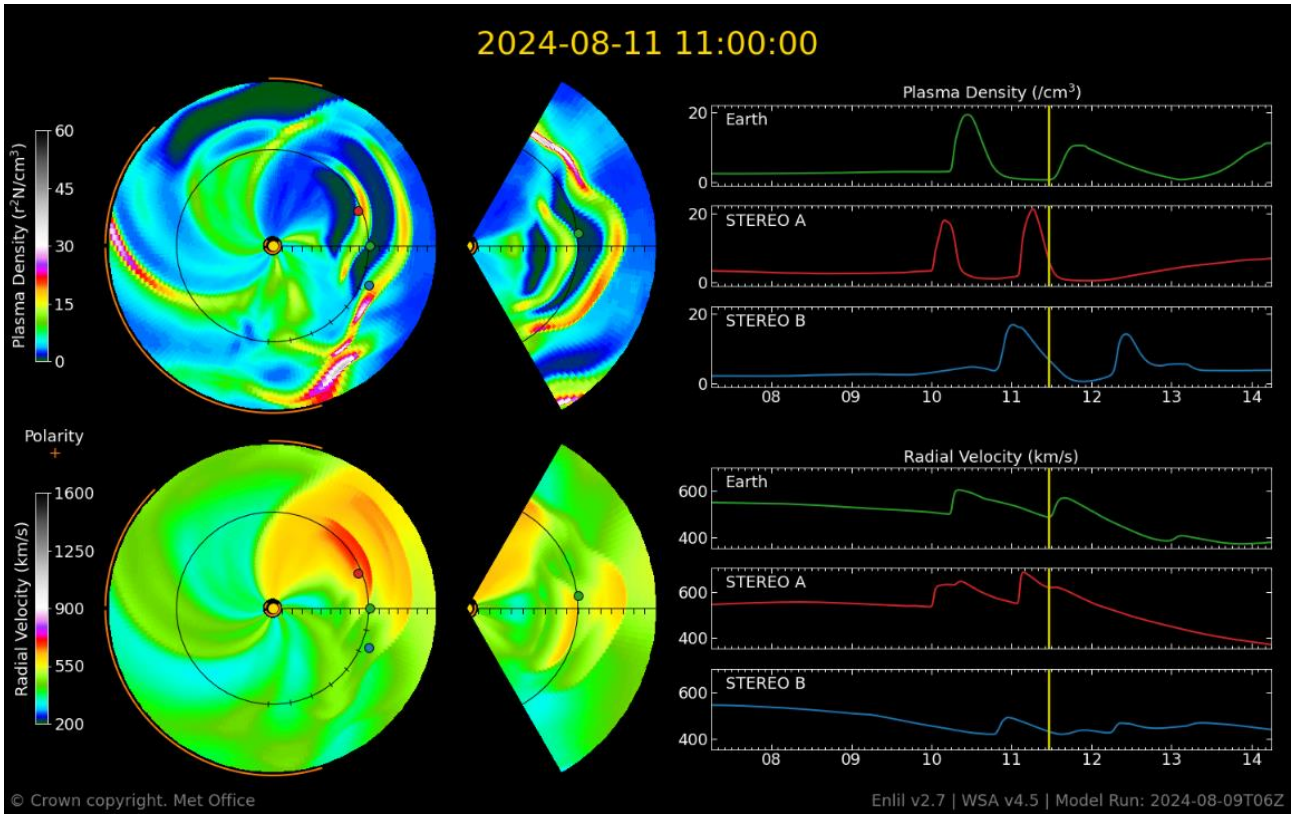

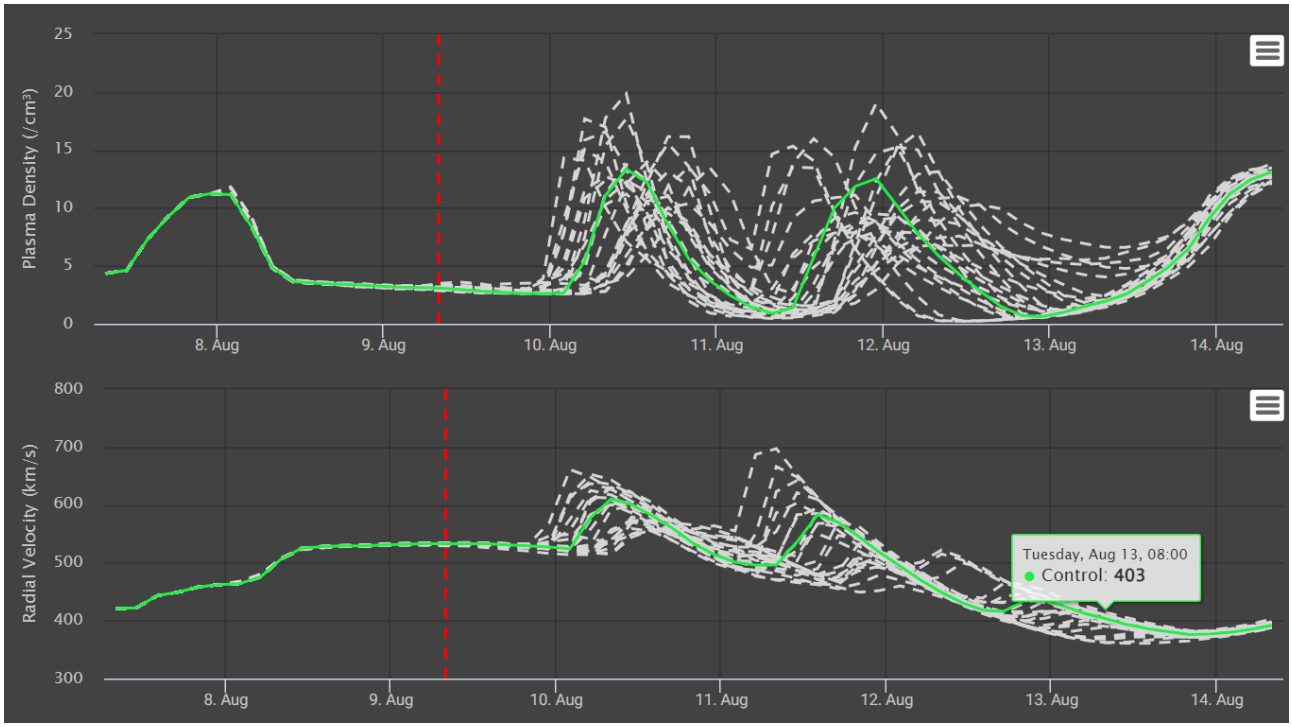

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Radio Blackouts - X-Ray Flares:

There are nine sunspot regions visible on the disc. AR3780 remains the largest, with moderate magnetic complexity, featuring a prominent large negative intermediate spot and a cluster of smaller spots to its south and west. AR3774 and AR3777 remain moderately size regions located close together in the southwest, with AR3777 showing a slightly more complex magnetic structure. AR3781 is a relatively small region to the northwest, however it appears to have a small delta region in its trailing spot. The remaining regions on the disc have either been stable or shown very little change.

Solar activity has been High with one X-class flare and three M-class flares observed in the past 24 hours, with a peak flare of X1.3 at 08/1935 UTC from AR3777. Further M-class flares are expected with a slight chance of an isolated X-class flare.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	Yes	20	20	20	20

Figure 3: X-ray flux plot at GEO from GOES satellite data.

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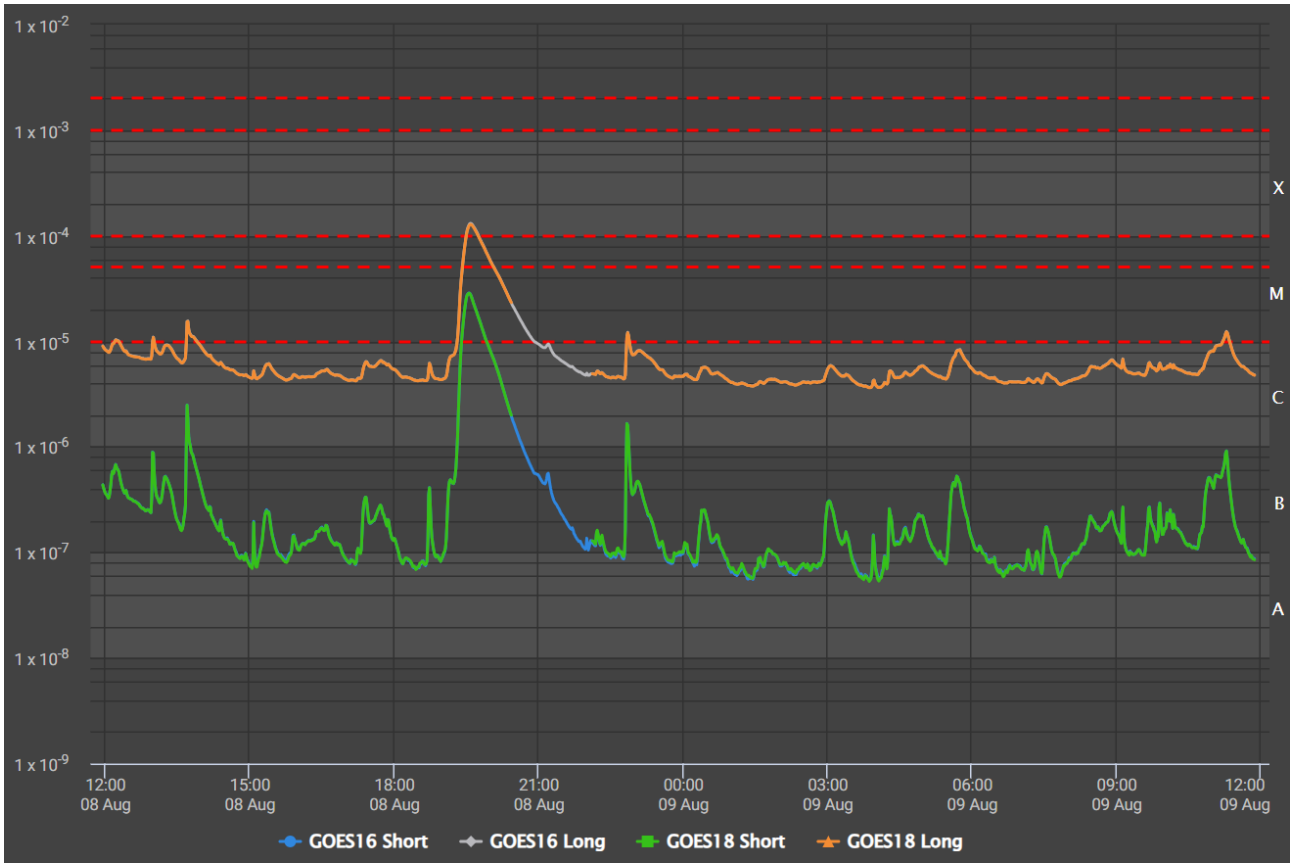

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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, was at background throughout the period. Any strong flares will bring the potential for a slight chance of reaching/exceeding the S1 Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	20	20	20	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background. In the absence of any notable fast wind arrivals, the observed flux is expected to remain at or near background level.
The associated 24hr electron fluence is expected to remain below Active (1e8 integrated pfu).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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